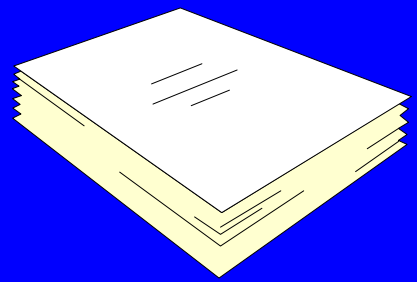
Pre-Test Determinations & Test Notes



Vehicle-Tank Meters

NIST Short Course

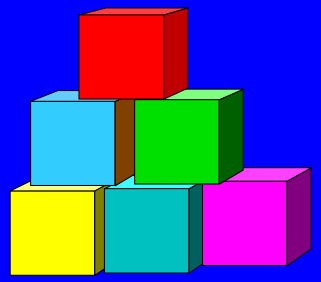
Pretest Determinations - Test Liquid

- identity of product normally dispensed
- product for test must be similar in characteristic to fluid to be measured (N.1.)
- coefficient of expansion may be different
  - can be critical
- chemical properties may be different
  - viscosity, lubricity, etc.
  - can result in differences in performance in meter
    - viscous products may result in less slippage through meter

Pre-Test Determinations - Test Draft Size

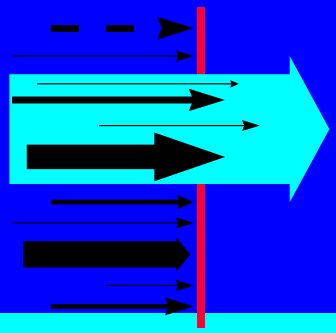
N.3. Test Drafts. - Test drafts should be equal to at least the amount delivered by the device in one minute at its normal discharge rate.

(Amended 1982)



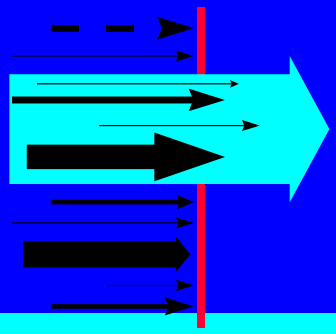
Preparation for Testing

- should already have test equipment set up
- record basic information:
  - date of test
  - name & address of operator/owner
  - device make, model, size, S/N
  - max/min discharge rate
  - accessory devices
  - totalizer readings; including money-value totalizers, if equipped
  - important for recordkeeping and determining test parameters



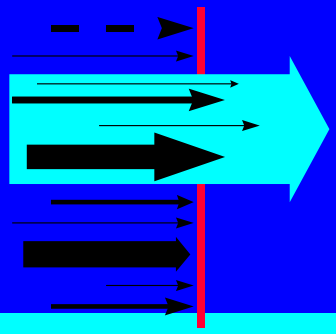
Tolerances--Overview

- devices are not capable of **errorless** performance
- tolerances designed to permit measurement errors small enough not to cause serious economic hardship to the buyer or seller…
  yet…
  not so **small** as to make the cost of manufacturing equipment unreasonably high
- industry often establishes more stringent requirements for themselves



Applying Tolerances

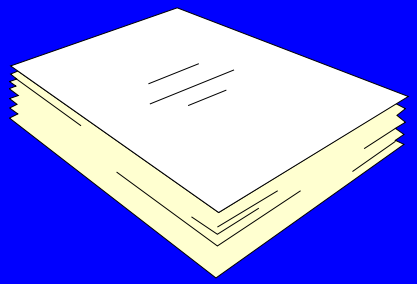
- tolerances are for the device
- tolerances are based on the indicated amount



Determining Tolerances

- determine applicable tolerances

- need to know:
  - length of time device has been in service
  - type of test being performed
  - size of test draft
  - product type
    - different tolerances for agri-chemicals & others



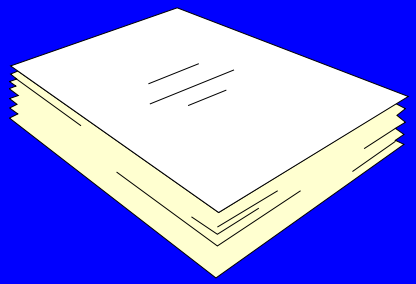
Acceptance Tolerances

G-T.1., Acceptance Tolerances. -

Acceptance tolerances shall apply to:

(a) equipment to be put into commercial use for the first time;

(b) equipment that has been placed in commercial service within the preceding 30 days and is being officially tested for the first time;



Acceptance Tolerances (cont.)

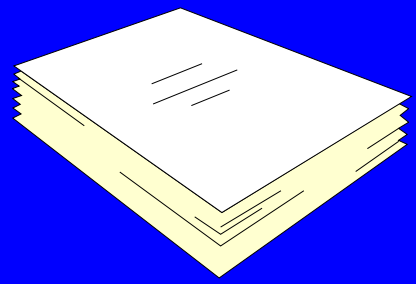
(c) equipment that has been returned to commercial service following official rejection for failure to conform to performance requirements and is being officially tested for the first time within 30 days after corrective service;

(d) equipment that is being officially tested for the first time within 30 days after major reconditioning or overhaul; and

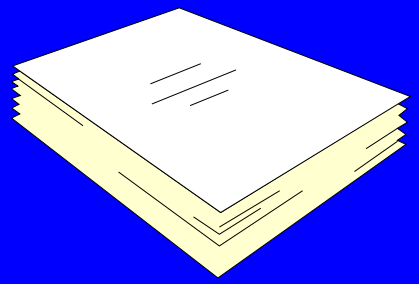
(e) equipment undergoing type evaluation.

(Amended 1989)

Maintenance Tolerances



G-T.2. Maintenance Tolerances. - Maintenance tolerances shall apply to equipment in actual use, except as provided in G-T.1.



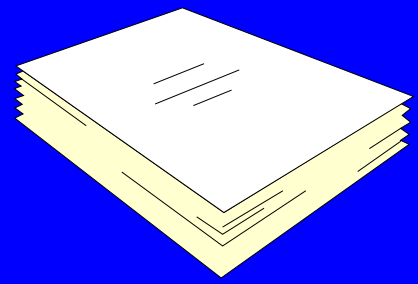
N.4.1. Normal Tests

- tests made at the maximum discharge rate anticipated under the conditions of installation
- also includes additional tests conducted at flow rates down to and including:

  1/2 x (maximum discharge flow rate + rated minimum discharge flow rate)

- Amended 1992

N.4.2. Special Tests



- made to develop the operating characteristics of a device and any special elements and accessories attached to or associated with the device
- includes any test except as set forth in N.4.1.
- conducted at:
  - 20 percent of the marked maximum discharge rate, OR
  - at the minimum discharge rate marked on the device,
  - which ever is less
- conducted to develop operating characteristics of the measuring system during a split-compartment delivery

VTM Code, NIST Handbook 44 - Table 1. Tolerances

Table 1.
Tolerances for Vehicle-Tank Meters Except for Vehicle-Mounted Milk Meters, Agri-Chemical Meters, and Water Meters

	Normal tests		Special tests
Indication	Maintenance tolerance	Acceptance tolerance	Maintenance and acceptance tolerance
(Gallons)	(Cubic inches)	(Cubic inches)	(Cubic inches)
50	50	25	50
Over 50	Add 1/2 cubic inch per indicated gallon over 50	Add 1/4 cubic inch per indicated gallon over 50	Add 1 cubic inch per indicated gallon over 50

Sample Calculation of Tolerances 100-gallon Test Draft - Normal Test

Acceptance Tolerance:

- 25 cubic inches for first 50 gallons *plus*
- 1/4 cubic inch per gallon over 50

So, for 100-gallon draft:

(25 cubic inches) +

(1/4 x 50) = 25 + 12.5

= 37.5 cubic inches

Sample Calculation of Tolerances 100-gallon Test Draft - Normal Test

Maintenance Tolerance:

- 50 cubic inches for first 50 gallons *plus*
- 1/2 cubic inch per gallon over 50

So, for 100-gallon draft:

(50 cubic inches) +

(1/2 x 50) = 50 + 25

= 75 cubic inches

Sample Calculation of Tolerances 100-gallon Test Draft - Special Test

Maintenance & Acceptance Tolerance:

- 50 cubic inches for first 50 gallons *plus*
- 1 cubic inch per gallon over 50

So, for 100-gallon draft:

(50 cubic inches) +

(1 x 50) = 50 + 50

= 100 cubic inches

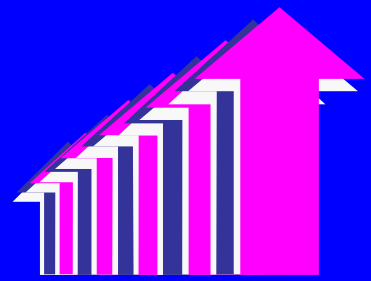
G-S.5.4. Repeatability

G-S.5.4. Repeatability of Indications. - A device shall be capable of repeating, within prescribed tolerances, its indications and recorded representations. This requirement shall be met irrespective of repeated manipulation of any element of the device in a manner approximating normal usage (including displacement of the indicating elements to the full extent allowed by the construction of the device and repeated operation of a locking or relieving mechanism) and of the repeated performance of steps or operations that are embraced in the testing procedure.

T.4. Repeatability

- when multiple tests are conducted at approximately the same flow rate and draft size
- range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance
- the results of each test shall be within the applicable tolerance
- see also N.4.1.2.
- amended 2001

Repeatability



- multiple tests under reasonably similar conditions
  - similar flow rate
  - similar temperatures
  - same test draft size and test product
- paragraph T.4.
  - results of repeated tests must be within 40% of absolute value of ***maintenance*** tolerance
  - each test must also be within applicable tolerance

Example #1 of Repeatability Tolerance Two 100-gallon Test Drafts (Maintenance)

- Two 100-gallon test drafts
- Normal tests at about the same flow rate
- If “applicable tolerance” is maintenance:
  - maintenance = +/- 75 cubic inches (in^3)
  - absolute value of maintenance tolerance = 75 cubic inches

Example #1 (cont) of Repeatability Tolerance Two 100-gallon Test Drafts (Maintenance)

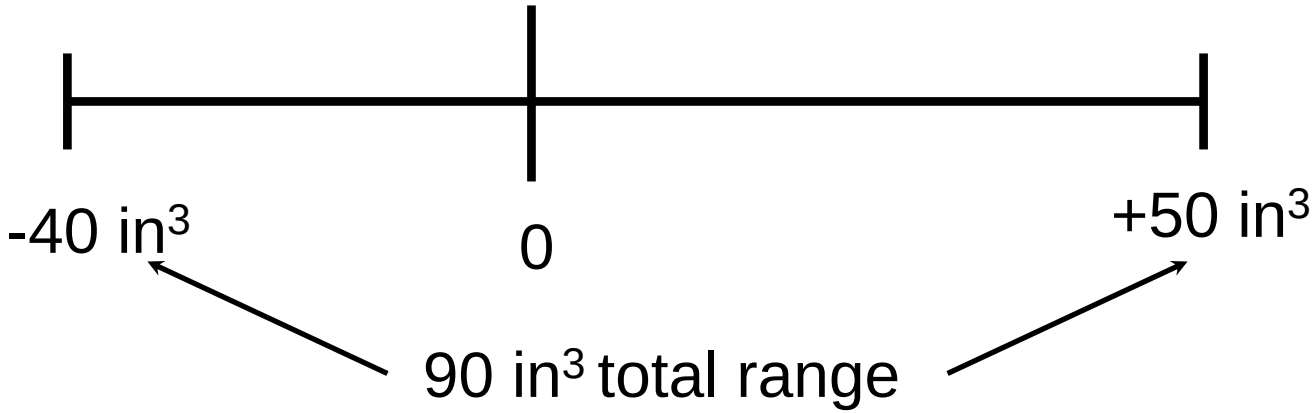
- Repeatability tolerance
  - 40% of absolute value of maintenance tolerance =

    $0.40 \times 75\ in^3 = 30\ in^3$

    = acceptable range between results of repeated tests

- If results are:
  - Test#1: $-40\ in^3$
  - Test#2: $+50\ in^3$
  - Range of results is $90\ in^3$ (from -40 to $+50\ in^3$)

Example #1 (cont) of Repeatability Tolerance Two 100-gallon Test Drafts (Maintenance)



Conclusions:

- each individual test is within the applicable tolerance of +/- 75 in³

  However

- 90 in³ range of test results exceeds the 30 in³ repeatability tolerance

Example #2 of Repeatability Tolerance Two 100-gallon Test Drafts (Acceptance)

- Two 100-gallon test drafts
- Normal tests at about the same flow rate
- If “applicable tolerance” is acceptance:
  - acceptance = +/- 37.5 cubic inches (in^3)
- Recall:
  - maintenance = +/- 75 cubic inches (in^3)
  - absolute value of maintenance tolerance = 75 cubic inches

Example #2 (cont) of Repeatability Tolerance Two 100-gallon Test Drafts (Acceptance)

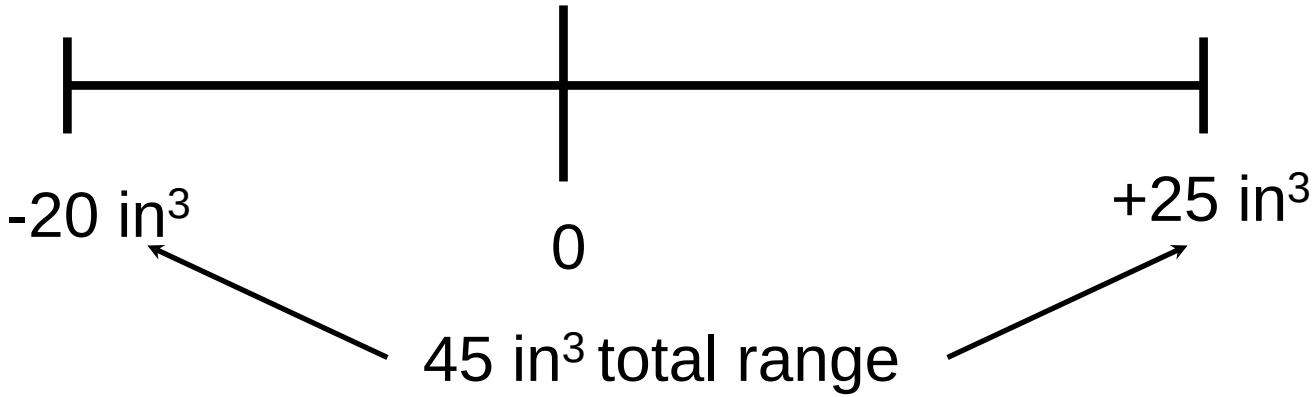
- Repeatability tolerance
  - 40% of absolute value of maintenance tolerance =

    $0.40 \times 75\ in^3 = 30\ in^3$

    = acceptable range between results of repeated tests

- If results are:
  - Test#1: $-20\ in^3$
  - Test#2: $+25\ in^3$
  - Range of results is $45\ in^3$ (from -20 to $+25\ in^3$)

Example #2 (cont) of Repeatability Tolerance Two 100-gallon Test Drafts (Acceptance)



Conclusions:

- each individual test is within the applicable tolerance of 37.5 in³

  However

- 45 in³ range of test results exceeds the 30 in³ repeatability tolerance

Test Notes--General

- wet prover
- allow 30-second drain each time prover is emptied
- avoid evaporation and volume change
  - exercise care that product temperature is same in prover as at meter
- primary indications and recording elements checked for comparability, legibility
  - printed ticket after each test draft
- computing devices - check price computations after each draft
- check totalizers after each draft

Rounding Using the Odd/Even Rule

- find the place to which you want to round (e.g., to nearest 0.1 or to the nearest 0.01, etc.). This is the “last digit to be retained.”
- look at the digit to the right of this number. This is the “first digit to be dropped.”
- If the first digit to be dropped is:
  - < 5 round down
  - > 5 round up
  - = 5 followed by zeros, round to even number

Applying the Odd/Even Rule

Rounding Using the Odd/Even Rule		
When the First Digit Dropped is:	**The Last Digit Retained is:**	**Examples**
< 5	**Unchanged**	**2.44 to 2.4**
> 5	**Increased by 1**	**2.46 to 2.5**
5 followed by zeros	**Unchanged if Even, or Increased by 1 if Odd**	**2.450 to 2.4 2.550 to 2.6**

Rounding Examples

- Round 1.23 gallons to nearest 0.1 gallon:
  - 2 is the last digit to be retained
  - 3 is the first digit to be dropped
  - since 3 is less than 5, the last digit to be retained is unchanged (e.g., round down to 1.2 gal)
- Round 1.47 gallons to nearest 0.1 gallon:
  - 4 is the last digit to be retained
  - 7 is the first digit to be dropped
- since 7 is greater than 5, the last digit to be retained is increased by 1 (e.g., round up to 1.5 gal)

Pre-Test Determinations & Test Notes - Summary

- test liquid & test draft size
- tolerance determination
  - based on indicated amount
  - acceptance vs. maintenance
- tests to be performed
  - normal test, special tests
- wet prover
- avoid temperature changes
- check register and ticket for legibility, price computations, agreement